INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

23rd March 2017

Subject CT8 – Financial Economics

Time allowed: Three Hours (10.30 – 13.30 Hours)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

1. ***Please read the instructions inside the cover page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception.***
2. ***Mark allocations are shown in brackets.***
3. ***Attempt all questions, beginning your answer to each question on a separate sheet.***
4. ***Please check if you have received complete Question Paper and no page is missing. If so, kindly get new set of Question Paper from the Invigilator.***

AT THE END OF THE EXAMINATION
Please return your answer book and this question paper to the supervisor separately.

Q. 1) **i)** Explain what is meant by informational efficiency. What are the major difficulties involved with testing for informational efficiency? What are the empirical evidence concerning informational efficiency? (7)

ii) Discuss the following observations with reference to validity of Efficient Market Hypothesis

a) "One can consistently outperform the market by adopting the contrarian approach as low P/E stocks tend to have positive abnormal returns".

b) "Post a merger announcement, share prices fall immediately" (4)

[11]

Q. 2) A consumer has utility function for goods X and Y given by

$$U(X, Y) = X^{0.4}Y^{0.6}$$

i) What is the consumer's marginal utility of X and Y? (2)

ii) Suppose the price of X is 2 and price of Y is 6. What is the utility-maximizing proportions of X and Y in his consumptions? (2)

iii) If the total amount of money he is willing to spend on the two goods is equal to 60, how much of each will he consume? (2)

iv) Using an appropriate utility function as an example, show that maximizing expected wealth is not same as maximizing expected utility. State your assumptions.

(4)

[10]

Q. 3) The stochastic process X follows the SDE given by

$\frac{dXt}{Xt} = 0.25\ dt + \sigma\ dWt$ where W is a standard Brownian motion.

Consider the new process Y defined by Yt = f(t, Xt) where

$f(t, x) = e^{-t}x^2$

i) Write an expression for dYt (4)

ii) Under what condition will the process be a martingale? (1)

[5]

Q. 4) A company has a single zero coupon bond outstanding that matures in 10 years with a face value of INR 30 million. The company has as option to buy back the bond at maturity. The current value of the company's assets is INR 22 million, and the standard deviation of the return on the firm's assets is 39 percent per year. The risk-free rate is 6 percent per year, compounded continuously.

i) What is the current market value of the company's equity? (3)

ii) What is the current market value of the company's debt? (1)

iii) What is the company's continuously compounded cost of debt per year? (2)

iv) The company has a new project available. The project has an NPV of INR 750,000. If the company undertakes the project, what will be the new market value of equity? Assume volatility is unchanged. (2)

v) Assuming the company undertakes the new project and does not borrow any additional funds, what is the new continuously compounded cost of debt per year? What is happening here? (2)

[10]

Q. 5) i) Derive the Black Scholes PDE for a dividend paying share, while carefully stating the assumptions (4)

ii) You purchase one call and sell one put with the same strike price and expiration date. What is the delta of your portfolio? Explain the result (2)

iii) The company's position on exchange rate (rupee / dollar) has a delta of 50,000 and gamma of -100,000. Explain the statements (2)

iv) The exchange rate is 0.9 (rupees per dollar). Assuming delta as in part iii), what cash position would make the portfolio delta neutral? (2)

v) The exchange rate moves to 1.0 in a short period. Estimate the new delta (2)

vi) What additional trade is necessary to keep the position delta neutral? What can you say about the company's financial impact from the exchange rate movement? (3)

[15]

Q. 6) i) Explain what is meant by a recombining binomial tree. State the advantage and disadvantage of using a recombining tree [vis-à-vis a non-recombining tree] to model share price movements. (4)

ii) A trader in derivatives is using a two-step binomial tree to determine the value of a 6-month European put option on a non-dividend-paying share. The put option has a strike price of Rs. 950. The trader assumes that during the first 3 months, the current share price of Rs. 1000 will either increase by 10% or decrease by 5%. The continuously compounded risk free rate during the first 3 months is 1.75%. During the following 3 months, the trader assumes that the share price will either increase by 20% or decrease by 10%. The risk free rate during this period is expected to be 2.5%

a) Calculate the value of the put option. (6)

b) The trader believes that a more accurate value of the put option can be determined by dividing the term of the option into "months". State the disadvantages of applying this modification to the model; and suggest an alternative model based on months that might be efficient numerically. (4)

[14]

Q. 7) i) Suppose stock returns can be explained by the following three-factor model. Assume there is no firm-specific risk. The risk premiums for the factors are 5.5 percent, 4.2 percent, and 4.9 percent, respectively.

Stock	β1	β2	β3
A	1.1	0.75	0.3
B	0.7	1.5	-0.75
C	1.2	-0.1	1.9

You have created a portfolio with 20 percent invested in stock A, 20 percent invested in stock B, and the remainder in stock C. State the expression for the return of your portfolio. (3)

ii) If the risk-free rate is 3.5 percent, what is the expected return of your portfolio? (1)

iii) Compare the prices of a zero coupon bond that matures in 5 years using Vasicek and Cox, Ingersoll, Ross model. Suppose that $\alpha = 0.1$ and $\mu = 0.1$ in both the models. In addition, in both the models, the initial short rate is 7% and the initial standard deviation of the short rate change in a short time is $0.02\sqrt{\Delta t}$. (4)

[8]

Q. 8) **i)** Let $\{Z(t)\}$ be a standard Brownian motion. You are given:

a. $U(t) = 2Z(t) - 2$
b. $V(t) = [Z(t)]^2 - t$
c. $W(t) = t^2 Z(t) - 2\int_o^t sZ(s)ds$

Derive the SDEs and explain which of the processes defined above has / have zero drift? (9)

ii) Assume a firm has asset value, V0 = 100, and asset volatility, σV = 0.30. The firm has an outstanding one year (T = 1) debt with a face value of F = 60. The risk free rate for a year is 5% continuously compounded. The beta value of the firm's assets is estimated as $\beta = 1.5$, and the market risk premium is taken as 6%.

a) What is the expected growth rate of the assets of the firm? (1)

b) Compute the default probability over the one year time horizon assuming that asset price follows Geometric Brownian Motion. (4)

[14]

Q. 9) Assume that the security returns are generated by a single index model such that

$R_i = \alpha_i + \beta_i R_M + e_i$

Where R_i is the expected return for security i and R_M is the market's excess return. β_i and α_i are constants, e_i is the random variable representing the component of return not related to the market. The risk free rate is 2%. Suppose also that there are 3 securities A, B and C characterized by the following data:

Security	βi	$E(R_i)$	$\sigma(e_i)$
A	0.8	10%	25%
B	1.0	12%	10%
C	1.2	14%	20%

i) If $\sigma_M = 20\%$, calculate the Variance of Securities A, B and C. (3)

ii) Now assume that there are infinite number of assets with return characteristics identical to those of A, B and C respectively.
What will be the mean and variance of the portfolio's excess returns if:

a) The well diversified portfolio comprised of security A only. (1)

b) The well diversified portfolio comprised of 55% of type B and 45% of type C securities. (2)

c) Explain if there is an arbitrage opportunity in this market. (2)
[8]

Q. 10) **i)** Define:

a) Credit Risk (1)

b) Credit spread (1)

ii) Illustrate how the Merton Model can be used to estimate the risk neutral probability of default on the Company's bonds. (3)
[5]

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